

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Comprehensive Fishery Survey of Ludden Lake

Iowa County, Wisconsin 2023



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Executive Summary

The Wisconsin Department of Natural Resources (DNR) conducted a comprehensive survey of Ludden Lake in 2023. The primary focus of this survey was to estimate the abundance and size structure of the walleye population and assess the relative abundance and size structure of other gamefish and panfish populations in the lake. DNR staff also assessed the current status of common carp in Ludden Lake to determine if a rough fish removal project is warranted.

Spring surveys estimated the walleye population at 2.3 fish per acre >15 inches with a catch rate of 1.05 per net night. Yellow perch catch rates were low during spring netting surveys, capturing only 43 fish (1.19 per net night). Largemouth bass were relatively high in abundance, capturing 33 fish (27.3 fish per mile) during spring electrofishing surveys. Bluegill catch rates were relatively low in 2023, capturing only 17.1 fish per mile. Lastly, black crappies were captured during spring electrofishing surveys at a rate of 169 fish per mile.

Overall, the Ludden Lake fishery is predominately focused on bass and bluegill. Bass, bluegill and black crappie make up the majority of the biomass surveyed, although a small number of walleye and yellow perch were present. Management actions will focus on maintaining the current statewide regulations for all species present. Stocking of walleye will also be discontinued as these efforts have not led to a productive walleye fishery in Ludden Lake. Focus will also be placed on management of common carp, as this population is high and potentially contributing to water quality issues throughout the lake.

LAKE AND LOCATION

Ludden Lake, Iowa County
T5N, R2E Sections 25 and 36

PHYSICAL/CHEMICAL ATTRIBUTES

- Morphometry: 47 acres, maximum depth 9 feet
- Watershed: Pecatonica River
- Lake type: Drainage, impoundment of Mineral Point Branch
- Water clarity: Turbid
- Littoral substrate: Gravel, silt, muck
- Trophic status: Hypereutrophic
- Invasive species: Curly-Leaf Pondweed
- Winterkill: Infrequent
- Boat landings: One public boat landing is available

PURPOSE OF SURVEY

Baseline lake survey Tier 1 assessment.

Common Carp Population Estimate.

DATES OF FIELDWORK

Electrofishing surveys for the mark-recapture population estimate of common carp were conducted on August 16, 18, 29 and October 4, 2022.

SN1 fyke net surveys conducted March 31 through April 6, 2023.

Electrofishing surveys conducted April 7, 2023 (SE 1) and May 9, 2023 (SE2).

FISHERY

The Ludden Lake fishery consists mainly of bluegill, black crappie, largemouth bass, yellow perch and walleye.

Introduction

Ludden Lake is a 47-acre impoundment located in Iowa County, Wisconsin that was created in 1963. Ludden Lake is a hypereutrophic drainage lake with a maximum depth of 9 feet. The main inlet to Ludden Lake is Mineral Point Branch, but one other unnamed tributary also contributes to the waterbody. One dam regulates the waterbody on the south side of the lake and flows out to Mineral Point Branch below.

The lake has a number of gamefish, including bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromachulatus*), pumpkinseed (*Lepomis gibbosus*), green sunfish (*Lepomis cyanellus*), yellow perch (*Perca flavescens*), channel catfish (*Ictalurus punctatus*), largemouth bass (*Micropterus Salmoides*), smallmouth bass (*Micropterus dolomieu*) and walleye (*Sander vitreus*). Common non-game and forage fish include common carp (*Cyprinus carpio*), white sucker (*Catostomus commersoni*), shorthead redhorse (*Moxostoma macrolepidotum*) and black bullhead (*Ameiurus melas*). Invasive species are also present and include curly-leaf pondweed (*Potamogeton crispus*).

A few surveys have been completed on Ludden Lake since its creation. These include baseline monitoring surveys, special studies, as well as spring and fall standardized fishery assessments. This is the second comprehensive fishery survey conducted on Ludden Lake and the second comprehensive fishery survey report. The primary objectives of the survey were to assess the walleye, bass and panfish populations.

Management of the fishery in Ludden Lake has been relatively unchanged over the years. Historically, angling regulations have followed the general inland water regulations and no special regulations have been implemented on Ludden Lake. Stocking has also been common practice in Ludden Lake since its construction in 1963. A variety of game and non-game fish, including bluegill, largemouth bass, yellow perch, northern pike, walleye, black bullhead, fathead minnows and white sucker have been stocked. However, recent stocking events have focused mainly on walleye (Table 1). Walleye are typically stocked as small fingerlings, although in 2004, 2006 and 2013, thousands of fry were also stocked (Table 1).

Methods

Spring sampling began in late March 2023 following standard DNR spring netting (SN1) procedures listed in the DNR fish management handbook (Simonson 2015). Between May 31 and April 6, six net lifts were conducted at six netting locations for 36 net-nights to capture, measure and mark adult walleyes to estimate abundance. All walleyes that could be visually sexed as mature individuals or were greater than 15 inches were marked with a top caudal fin clip. Fyke nets (2 feet x 6 feet, $\frac{3}{4}$ -inch bar mesh, 3 feet x 6 feet, $\frac{3}{4}$ -inch bar mesh and 4 feet x 6 feet, $\frac{3}{4}$ -inch bar mesh) were set at ice-out and lifted daily. Nets were set in locations that have been previously determined as successful capture locations (Figure 1). Immediately after fyke netting

was completed, a single, entire shoreline, night boomshocker electrofishing survey was conducted on April 7 (SE1) to recapture walleyes to estimate abundance.

Following both the SN1 and SE1 surveys, we conducted a spring electrofishing (SE2) survey targeting centrarchids. The primary objective for this survey was to collect and measure bass and panfish. An entire shoreline night boomshocker electrofishing survey was conducted on May 9. Two bass/panfish stations were sampled and all centrarchids were collected (Figure 2). For the remainder of the entire shoreline survey, only bass were collected. One boat operator and two experienced technicians, using 3/8-inch mesh dip nets, conducted the surveys. A minimum of 100 panfish from each species were dipped from the tub and measured. Spines (black crappie and bass) and otoliths (bluegill) were also collected from a minimum of five fish per 1/2 inch length bin, per species, for aging analysis.

A common carp population estimate was also completed on Ludden Lake. This consisted of three marking runs on August 16, 18 and 29 of 2022, where all common carp encountered were marked with a floy tag and top caudal fin clip. One shoreline electrofishing recapture run was conducted on October 4, 2022. The Chapmans modification of the Peterson mark-recapture estimator was used to determine the number of carp in Ludden Lake and subsequently estimate the biomass in terms of pounds per acre.

POPULATION ASSESSMENT

DNR staff conducted an initial fyke net survey to mark walleyes. After this initial netting period, a spring electrofishing recapture event was also conducted. The objective of this recapture run was to collect previously marked walleyes to estimate abundance using Chapman's modification of the Peterson mark-recapture estimator (Ricker 1975):

$$N = \frac{(M+1)(C+1)}{(R+1)} - 1,$$

where C = number of walleyes captured in the electrofishing sample, M = number of walleyes marked during fyke netting, R = number of marked walleyes observed in the electrofishing sample. During the fyke net surveys, walleye spines were collected at a minimum of ten structures per 1-inch length bin for aging analysis. Similar to walleye, this population estimator was used for carp in Ludden Lake. The only difference was instead of using fyke net surveys for the marking runs, a series of electrofishing surveys were used to capture and mark carp. For all other species where population estimates could not be conducted, catch per effort (CPE) in terms of the number of fish per mile was calculated.

Aging analysis was conducted for structures collected during the spring fyke netting and electrofishing events. All structures were placed in individual scale envelopes to identify individual fish. Spines were dried, cut near the base, sanded to achieve maximum clarity and illuminated with a fiber optic light. Otoliths were embedded in

epoxy, cut with a low-speed diambond blade saw, sanded with 1,000-grit sandpaper and if necessary polished to achieve maximum clarity. Two readers then aged each structure until an age was agreed upon. If a discrepancy existed, a third reader was called upon to assist in age agreement.

The size structure and growth rates of individual species were also described. Mean length at age was computed based on the lengths of individual fish for each species sampled and compared to statewide averages to determine relative growth rates. Individual fish from each species that had weights associated with lengths were used to calculate relative weights (W_r) using methods provided by Anderson and Neumann (1996). Age length keys were then used to assign ages and assess the age structure of the entire sampled population from a subsample of aged fish. Fish within the subsample were assigned an age at their length. These ages were then extrapolated and applied to unaged fish in the whole sample based on the proportion of ages at each length, using 0.5-inch length bins.

Results

Summary of total catch and catch rates for gamefish sampled during 2023 surveys:

Survey Type	BLUEGILL	BLACK CRAPPIE	LARGEMOUTH BASS	YELLOW PERCH	WALLEYE
TOTAL CATCH					
Spring Netting 1 (SN1)	1,846	5,725	32	43	38
Spring Electrofishing 1 (SE1)					15
Spring Electrofishing 2 (SE2)	75	169	33		
CATCH PER EFFORT (CPE)					
SN1 (number/net night)	50.9	157.9	0.88	1.19	1.05
SE1 (number/mile)					11.5
SE2 (number/mile)	75	169	27.3		

Summary of total catch rates of common carp sampled during 2022 surveys:

Survey Type	COMMON CARP
Electrofishing – Marking Runs	1072
Electrofishing – Recapture Run – Total Fish Captured	543
Electrofishing – Recapture Run – Total Marked Fish Found	60

COMMON CARP POPULATION ESTIMATE

A total of 1,072 common carp were marked during the three electrofishing runs conducted in the fall of 2022. 543 fish were collected during the single electrofishing recapture sampling event, with a total of 60 recaptured carp. This translates to a population estimate of 9,568 common carp. Average length of all marked fish was 20.2 inches with a minimum of 15.6 inches and a maximum of 26.5 inches. Average weight of all marked common carp was 3.67 pounds. This translates to a biomass estimate of 747 pounds per acre.

SPRING FYKE-NETTING AND SPRING ELECTROFISHING 1

WALLEYE

A total of 33 adult (sexually mature) walleyes were marked during the SN1 surveys and 15 walleyes were recaptured during the SE1 survey. These numbers are down substantially from the last survey conducted in 2013, where 91 individual fish were marked during the fyke net surveys. This translates to a current estimated adult walleye population of 108 fish (2.3 per acre), with 95% CIs [58, 250] and a CV of 34%, which is relatively high. Given that the number of fish marked was so low, size specific population estimates were not calculated. The length of individual walleyes captured during spring netting surveys ranged from 16.8 to 30.0 inches, with an average of 19.3 (SD = 2.4; Figure 3). Female walleyes had a greater mean length, averaging 21.2 inches, compared to 18.1 inches for males. When sex could be determined, males were sampled with a greater proportion, sampling 64% males compared to 36% females. Growth rates were generally above the statewide average according to mean length at ages (Figure 4). Both male and female walleyes ages 4 and 5 were captured at highest rates with a few fish reaching age 12 and older (Figure 5). Relative weights indicated good condition overall, with a mean relative weight of 93 (SD = 7.0; Figure 6). In fact, 98% of the population exhibited relative weights over 80 and 13% of the population was above 100 (Figure 6).

YELLOW PERCH

A total of 43 yellow perch were captured during the fyke net surveys in 2023. This translates to a CPE of 1.19 fish per net night. These fish ranged in size from 5.1 to 10.4 inches in length, with an average of 8.1 (SD = 1.05; Figure 7). When sex could be determined, males were sampled with greater frequency, sampling 69% males and 31% females during the surveys. Considering that relatively few yellow perch were sampled throughout the survey, age and growth analysis were not completed. However, relative weights were still good overall, with a mean of 90 (SD=18.7) and 23% exhibiting relative weights over 100 (Figure 8).

SPRING ELECTROFISHING 2

LARGEMOUTH BASS

A total of 32 largemouth bass were collected during spring fyke net surveys at a rate of 0.88 fish per net night. 33 Largemouth Bass were also collected during the SE2

survey in 2023. Largemouth bass CPE during late spring electrofishing was calculated at 27.3 fish per mile, exhibiting a substantial increase from 2013, when CPEs were calculated at 1.5 fish per mile. Ludden Lake ranks high compared to other lakes in the complex riverine lake classification. The median catch rate for all other lakes is 3.7 fish per mile, with the 75th percentile at 14.5 fish per mile. The average length of fish captured was 12.9 (SD = 2.6) inches, ranging from 7.2 to 18.7 inches (Figure 9). The growth of largemouth bass is slightly above the statewide average up until age 6, when growth begins to slow and increase in variability (Figure 10). The age-4 and 5 year-classes were represented in higher numbers than other ages of largemouth bass (Figure 11). Largemouth bass were also in good condition overall, with a mean relative weight of 98 (SD = 9.7; Figure 12). In fact, 95% of the population exhibited relative weights over 80 and 49% of the population above 100.

BLUEGILL

A total of 1,846 bluegill were sampled during the fyke netting surveys and 75 were collected during late spring electrofishing surveys in Ludden Lake. CPE was calculated at 50.9 fish per net night during fyke netting and 75 fish per mile electrofishing. This was a major increase from 2013, where the catch rate of bluegill was 15.8 fish per net night during netting and 17.1 fish per mile during electrofishing surveys. Ludden Lake ranks moderately high compared to other lakes in the complex riverine lake classification. Median catch rates for all other lakes is 39 fish per mile, with the 75th percentile coming in at 128.5 fish per mile. The mean length of all sampled bluegills averaged 6.12 (SD = 0.84) inches, with a minimum of 3.2 inches and a maximum of 8.6 inches (Figure 13). Bluegill showed excellent growth rates in Ludden Lake, reaching 7 inches by age-4 on average (Figure 14). Age-2 and age-3 bluegill were the most well represented year classes during this survey (Figure 15). Bluegills were also in good condition overall with a mean relative weight of 90 (SD = 14.1; Figure 16). Overall, 81% of the individuals sampled exhibited relative weights over 80 and 20% were above 100.

BLACK CRAPPIE

A total of 5,725 black crappie were sampled during the spring fyke netting survey in 2023. CPE was calculated at 157.9 fish per net night, which is approximately double the number that was surveyed in 2013 where 86.5 fish per net night were collected. During the spring electrofishing survey (SE2), 169 black crappies were surveyed at a rate of 169 fish per mile. This was also an increase from the 7.1 fish per mile captured during the electrofishing survey in 2013. Mean length of all sampled black crappie during fyke net surveys was 7.16 (SD = 1.05) inches, with a minimum of 3.2 inches and a maximum of 13.0 inches (Figure 17). Growth rates for black crappie were relatively low in Ludden Lake when compared to other lakes statewide (Figure 18). The age-2 year-class was the most abundant surveyed in 2022, with consistent declines from ages three to eight (Figure 19). To no surprise, relative weight of black crappie was low with only 3% of fish having relative weights over 80 and only one fish with a relative weight exceeding 100 (Figure 20).

Discussion

Ludden Lake is a small impoundment that reflects a relatively productive bass and panfish fishery. Historically, large efforts have been made to establish a fishable walleye population in the lake, despite its small size and shallow nature. Given the numerous stocking events over the years and lack of returns, this has failed to produce a substantial population. On the other hand, over the last ten years, bass and panfish species in the lake have increased in both abundance and size structure. It appears that Ludden Lake should be managed for these species, given their success in recent years. Overall, this small impoundment shows the most potential as a bass/panfish fishery, and efforts should be focused on these species. Given the high abundance and biomass of common carp, conversations will also need to be held regarding management of this species and the possibility of initiating a carp removal project. If this is the case, potential significant changes to water quality and lake vegetation are anticipated.

The walleye fishery in Ludden Lake has been completely dependent on DNR stocking. These stocking events occurred on odd years at a rate of between 22 and 64 small fingerlings per acre. One recent stocking event in 2013 also consisted of 50,000 fry. Despite these stocking events, the walleye population continues to decline, representing approximately half of what it was in 2013. Given this decline and reductions in stocking across the state, walleye stocking in Ludden Lake should likely be discontinued due to the lack of returns. This coupled with small lake size and shallow depth make it unlikely that continuation of stocking will produce a productive walleye fishery in Ludden Lake. Growth rates of walleye were slightly above average compared to other populations statewide. Fish ages 4 and 5 made up the majority of the fish sampled in Ludden Lake, although ages ranged from age-3 through age-14. Interestingly, fish were aged in each age class from 3 through 9, even though we know stocking only occurred during odd years. This alludes to the fact that either natural reproduction is occurring or aging error occurred during analysis. Many of our populations in southern Wisconsin do not have successful natural reproduction and therefore the latter may be more likely. Overall, growth was fast and on average as individuals become vulnerable to harvest by age 3. Going forward, we will passively manage Walleye in Ludden Lake and future assessments will give us insight on whether or not natural reproduction is occurring in light of stocking reductions.

Yellow perch were encountered during fyke net surveys in 2023, a species that was not sampled during any prior surveys of Ludden Lake. Only 43 yellow perch were encountered at 1.19 per net night. These fish were between 5 and 10 inches in length and had good relative weights overall. It is not known how yellow perch entered the system, as they have not been stocked in prior years. Size of these fish were also surprising, as yellow perch tend to not do well in small shallow impoundments like

Ludden Lake. Time will tell how these yellow perch survive and contribute to the fishery and DNR will take a passive role in management of this species.

Largemouth bass were much higher in abundance compared to surveys in 2013. Catch per effort was above the 75th percentile when compared to other complex riverine systems across the state. Age structure was relatively even across the board as fish were surveyed between two and nine years of age, exhibiting stable reproduction and recruitment. Mean length at age follows the statewide averages up until age 6 when growth begins to taper off. Mean length was 12.9 inches for fish captured during electrofishing surveys, an increase from 10.9 inches in 2013. Overall, largemouth bass seem to be doing quite well in Ludden Lake despite the turbid state of the lake and lack of nearshore vegetation. Currently, the bass population in Ludden Lake is regulated by the statewide regulation with a 14-inch minimum length limit and daily bag limit of 5. This regulation is appropriate, as these fish seem to have consistent reproduction and recruitment to the fishery, with numerous fish in the 9–14-inch range representing fish from 3–5 years of age. Therefore, we will continue to manage the bass population in Ludden Lake with the current regulation.

The number of bluegill increased substantially in 2023 from 2013. During surveys in 2023, we sampled a total of 1,846 total bluegill at a rate of 50.9 per net night. This was an increase from the 15.8 fish per net night observed during the previous survey. Mean length also increased, from 5.4 inches in 2013 to 6.1 inches in 2023. This is surprising, given the higher relative abundance of bluegill as well as abundance increases observed in other species. Age-2 and age-3 bluegill dominated the fishery, representing five and six inch fish on average. Growth of these fish was also good, as mean length at ages were also above statewide averages for all age classes sampled. Going forward, bluegill will continue to be a mainstay and among a favorite target for anglers in this impoundment.

The black crappie population was high and increased significantly from surveys conducted in 2013. Given that population levels have increased, it's no surprise that growth is slow overall. Fish between six to nine inches make up the majority of the fishery, ranging in ages from two to six on average. Even though numbers were high, it's unlikely that size structure of this population will reach a range that anglers tend to target. However, it is known from local contacts that many anglers choose to ice fish for crappies in Ludden Lake over the winter months when the lake is frozen. Given the boom-and-bust life cycle of black crappie, this population likely fluctuate over the next few years as some fish reach acceptable size for harvest. Based on the sheer numbers surveyed, anglers can expect good action while fishing for black crappies in the near future.

The common carp population in Ludden Lake is very high throughout. During fall electrofishing surveys, staff captured and marked 1,072 common carp. Through the recapture survey and population estimate, the number of common carp in Ludden Lake was estimated near 10,000 fish. Based on the average weight of carp sampled,

biomass estimates were approximately 747 pounds per acre. This number is very high and likely a main driver of the turbid state system that exists in the lake. A Biobase survey was completed in 2022 to map the current state of vegetation in the lake (Figure 21). It was found that very little vegetation exists within the lake and only in areas that are very shallow where sediment has accumulated. Both carp abundance and sediment transport from the upper watershed are impacting Ludden Lake and its water quality and clarity. If common carp are removed from this system, water clarity should improve and allow more vegetation growth within the lake. This will create more habitat for fish throughout the impoundment.

Sedimentation has been a large topic of concern in Ludden Lake over the years. Over the last ten years, maximum depth of Ludden Lake has decreased by 1 foot in the basin near the dam. In fact, maximum depth was 14 feet back in 1965 shortly after the lake was created. Therefore, Ludden Lake is losing approximately 1 foot of depth every 12 years, a problem that will continue to persist without intervention. A few options are available, although these would require significant efforts. One possible solution is to dredge the basin, a costly option that may be too far reaching for DNR or Ludden Lake Dam Commission. Another viable option is to draw down the lake completely and allow sediment compaction over the course of a year. This would require refilling the lake post compaction and stocking fish to reestablish fish populations. This would also set back the fishery a few years until populations are successfully repopulated. These conversations will need to be held between DNR staff and the Ludden Lake Dam Commission board, as well as stakeholders and adjacent landowners.

Management Recommendations

- 1) **Goal:** Maintain a high abundance of largemouth bass.
Objective: Manage for an SE2 catch rate of 15 fish per mile or greater (75th percentile for complex riverine).
Strategy: Continue managing with current statewide regulation.
- 2) **Goal:** Maintain high size structure and catch rates for bluegill.
Objective: Maintain mean length >4.6 inches (75% percentile for complex riverine). Maintain >39 fish per mile catch rate (50th percentile for complex riverine) during SE2 surveys.
Strategy: Continue managing with current statewide regulation.
- 3) **Goal:** Remove common carp from Ludden Lake.
Objective: Reduce biomass of common carp from 747 to <100 pounds per acre.
Strategy: Conduct detrimental species removal project with private contractor.

Additional Management Recommendations

- Discontinue stocking small fingerling walleye in Ludden Lake.
- Work with Ludden Lake Commission to develop lake habitat improvement plans.

References

- Anderson, R. O and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 *in* B. R. Murphy and D. W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.
- Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada, Bulletin 191.
- Simonson, T. 2015. Surveys and Investigations – Inland Fisheries Surveys. Fish Management Handbook Chapter 510, Wisconsin Department of Natural Resources internal publication. Madison, Wisconsin.



Figure 1. 2023 spring fyke netting locations on Ludden Lake.



Figure 2. Spring electrofishing 2 survey stations sampled in 2023. Red line refers to bass/panfish stations, while blue line refers to bass-only stations.

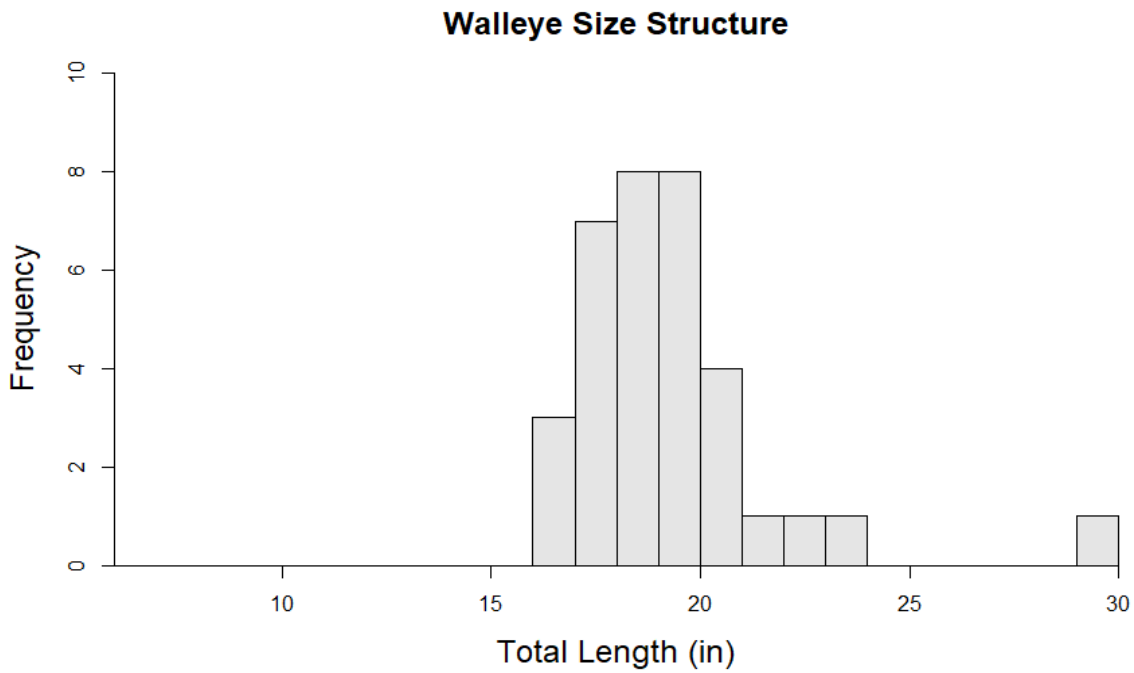


Figure 3. Walleye size structure from individual fish captured during spring fyke netting surveys.

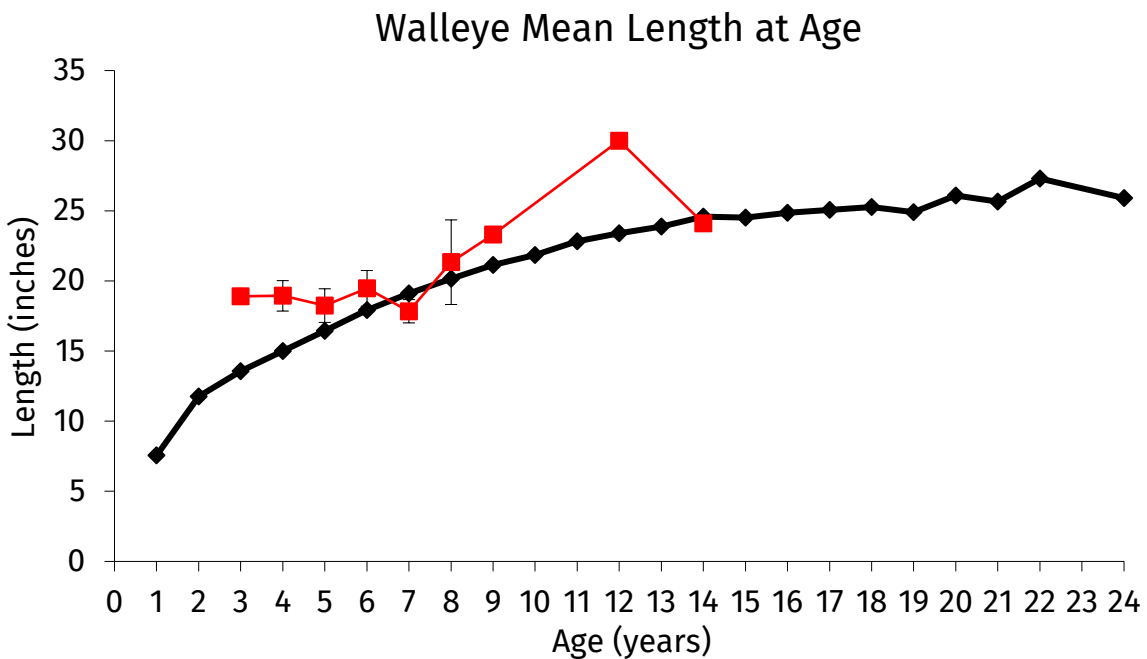


Figure 4. Walleye growth rates in comparison to statewide averages. Ludden Lake values are shown in red (± 1 SD); statewide averages are shown in black.

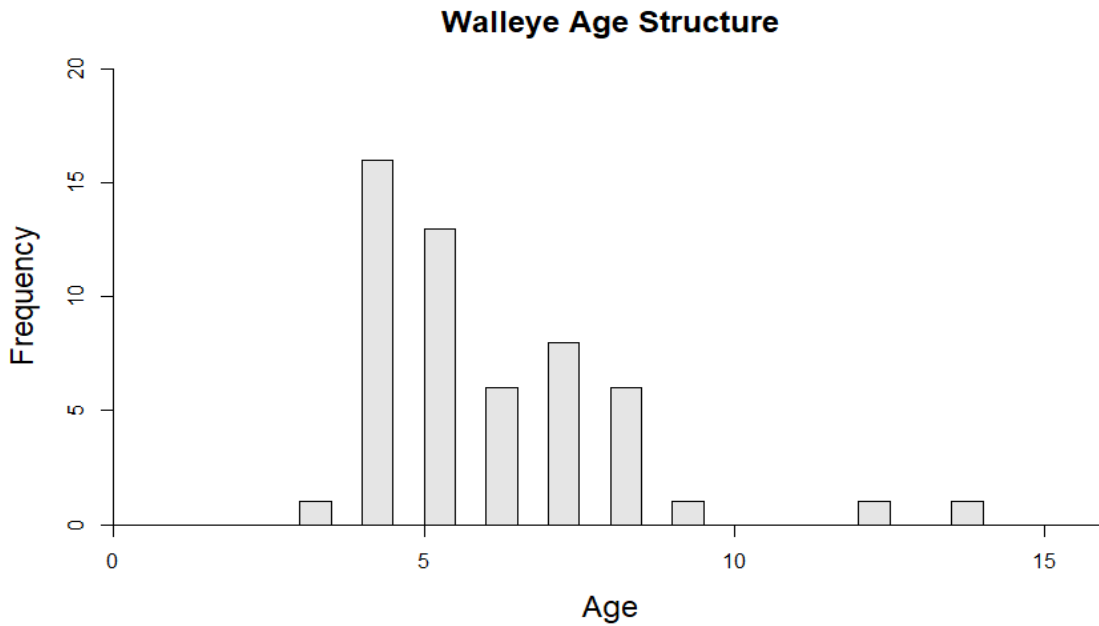


Figure 5. Age structure of all walleye collected during spring sampling in Ludden Lake. Lengths from aged fish were extrapolated and applied to unaged fish using age-length keys.

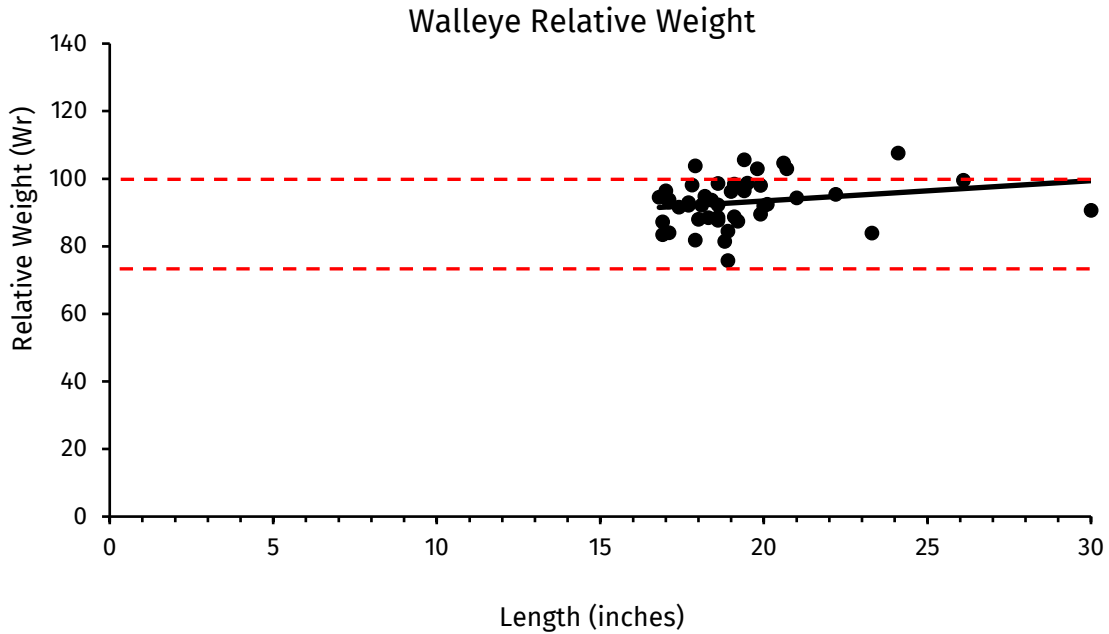


Figure 6. Relative weights of all walleye sampled during spring fyke netting surveys. Fish between 75 and 100 (designated by red dashed lines) are considered to be within the normal range.

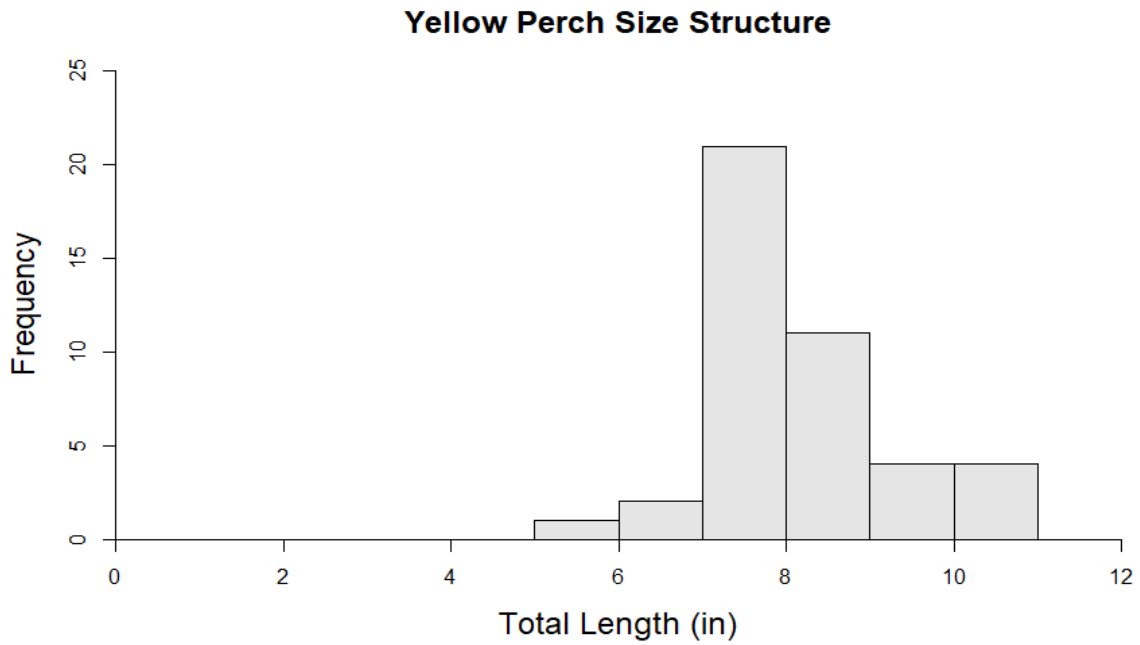


Figure 7. Yellow perch size structure from all fish captured during spring fyke netting surveys.

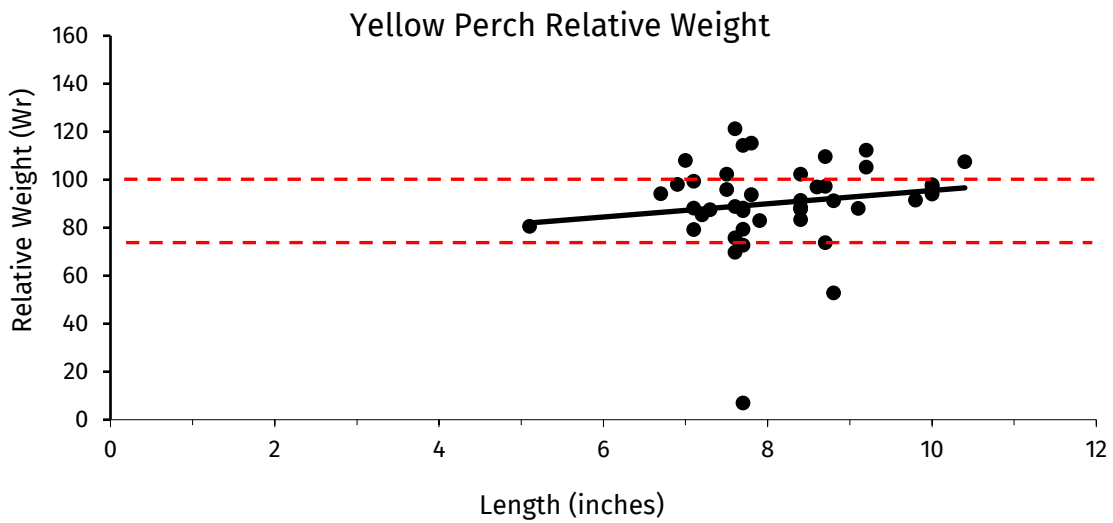


Figure 8. Relative weights of all yellow perch sampled during spring fyke netting surveys. Fish between 75 and 100 (designated by red dashed lines) are considered to be within the normal range.

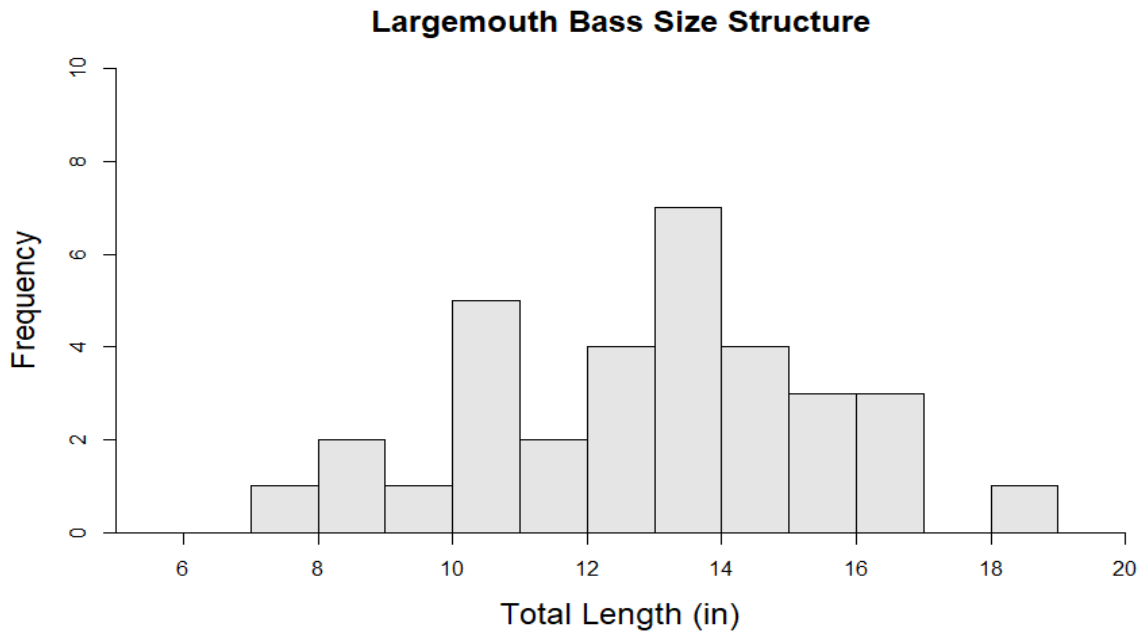


Figure 9. Largemouth bass size structure from individual fish captured during spring electrofishing surveys.

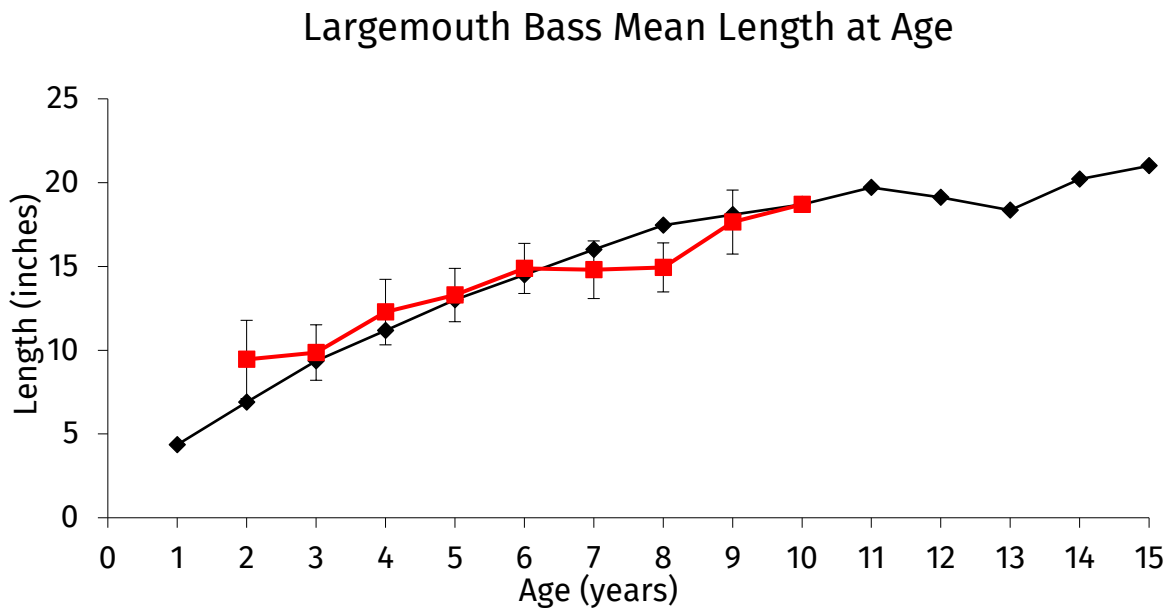


Figure 10. Largemouth bass growth rates in comparison to statewide averages. Ludden Lake values are shown in red (± 1 SD); statewide averages are shown in black.



Figure 11. Age structure of largemouth bass collected during spring sampling in Cox Hollow Lake. Lengths from aged fish were extrapolated and applied to unaged fish using age-length keys.

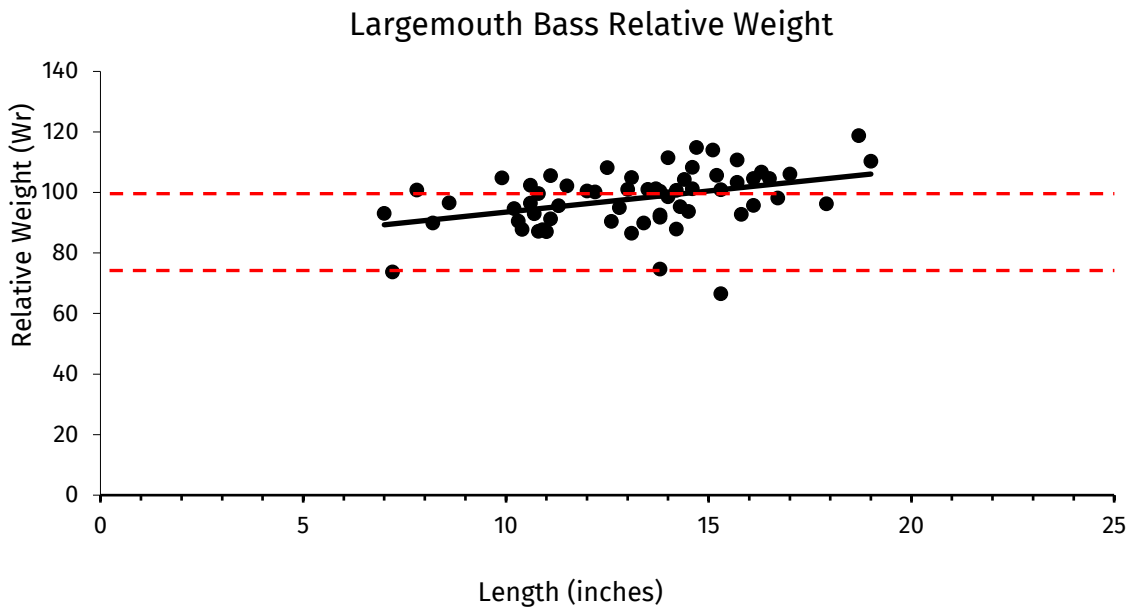


Figure 12. Relative weights of all largemouth bass sampled during spring electrofishing surveys. Fish between 75 and 100 (designated by red dashed lines) are considered to be within the normal range.

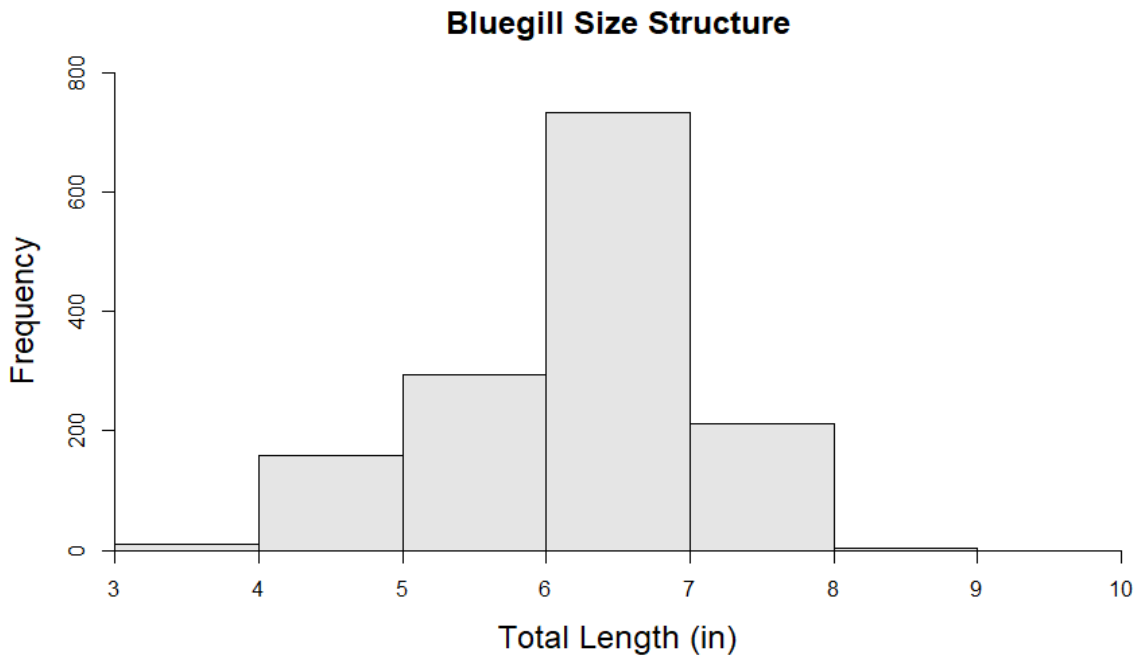


Figure 13. Bluegill size structure from individual fish captured during spring netting surveys.

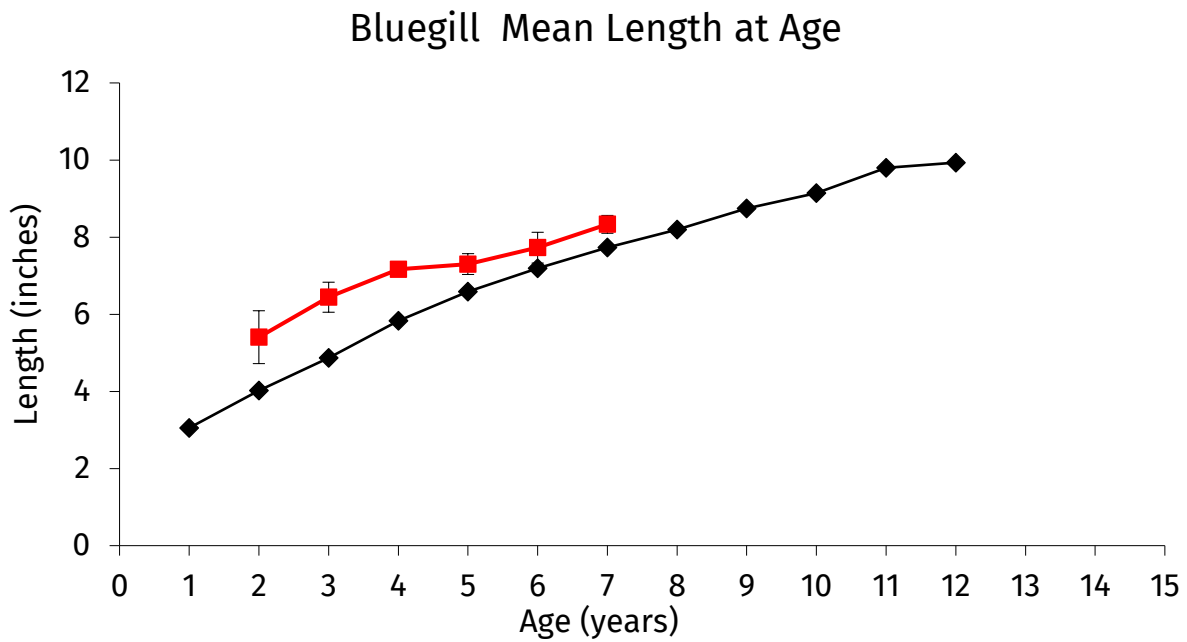


Figure 14. Bluegill growth rates in comparison to statewide averages. Ludden Lake values are shown in red (± 1 SD); statewide averages are shown in black.

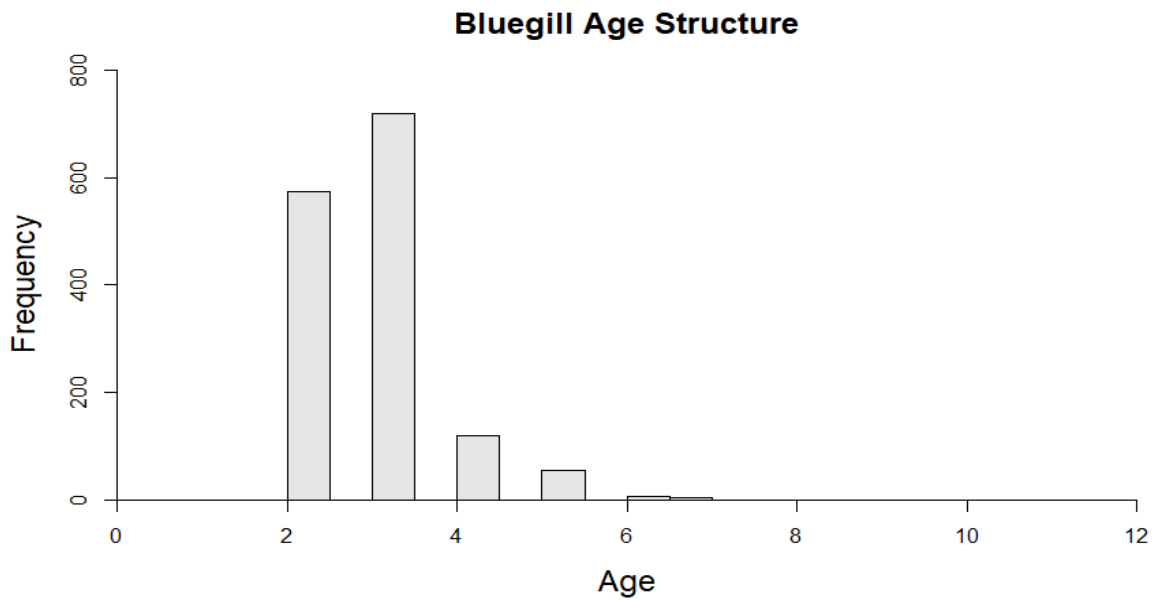


Figure 15. Age structure of bluegill collected during spring sampling in Cox Hollow Lake. Lengths from aged fish were extrapolated and applied to unaged fish using age-length keys.

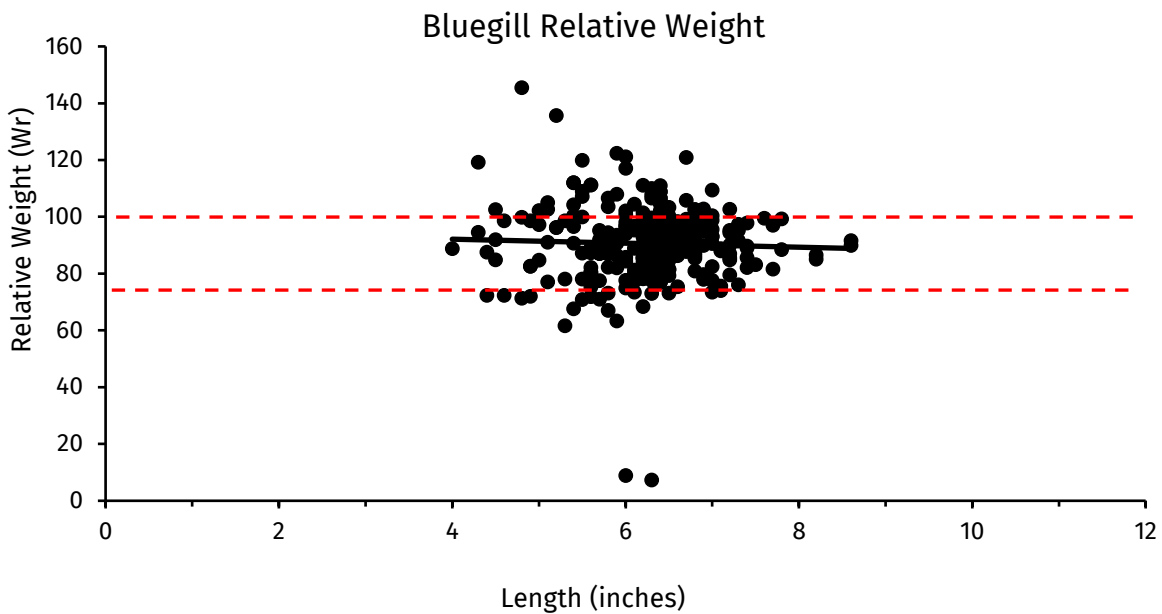


Figure 16. Relative weights of all bluegill sampled during spring electrofishing surveys. Fish between 75 and 100 (designated by red dashed lines) are considered to be within the normal range.

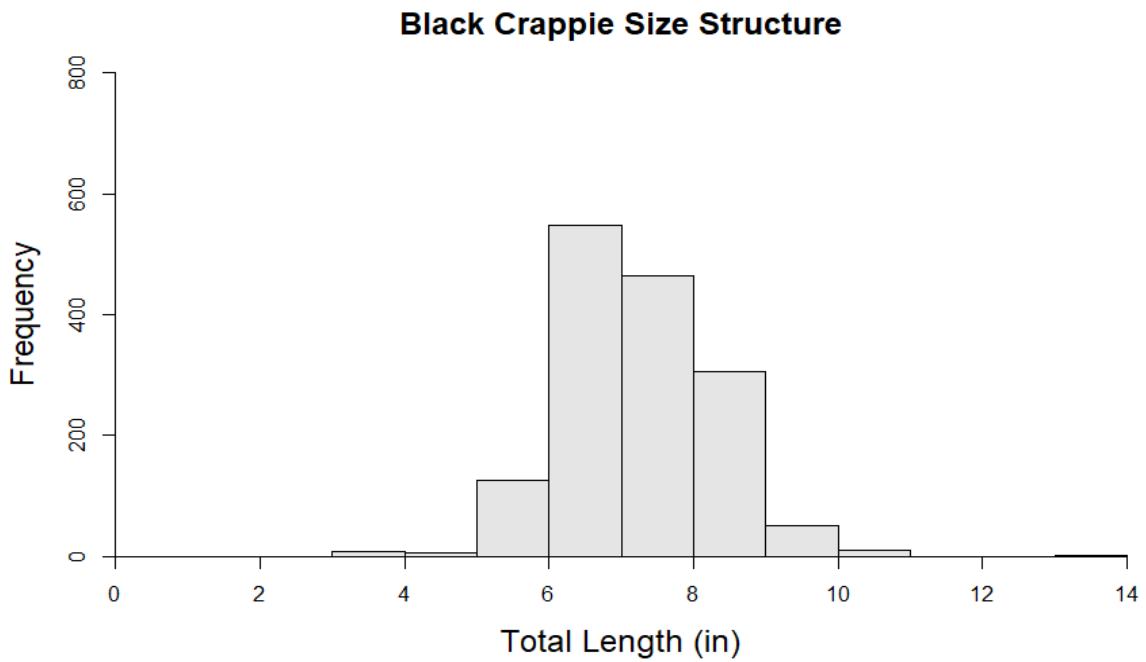


Figure 17. Black crappie size structure from individual fish captured during spring electrofishing surveys.

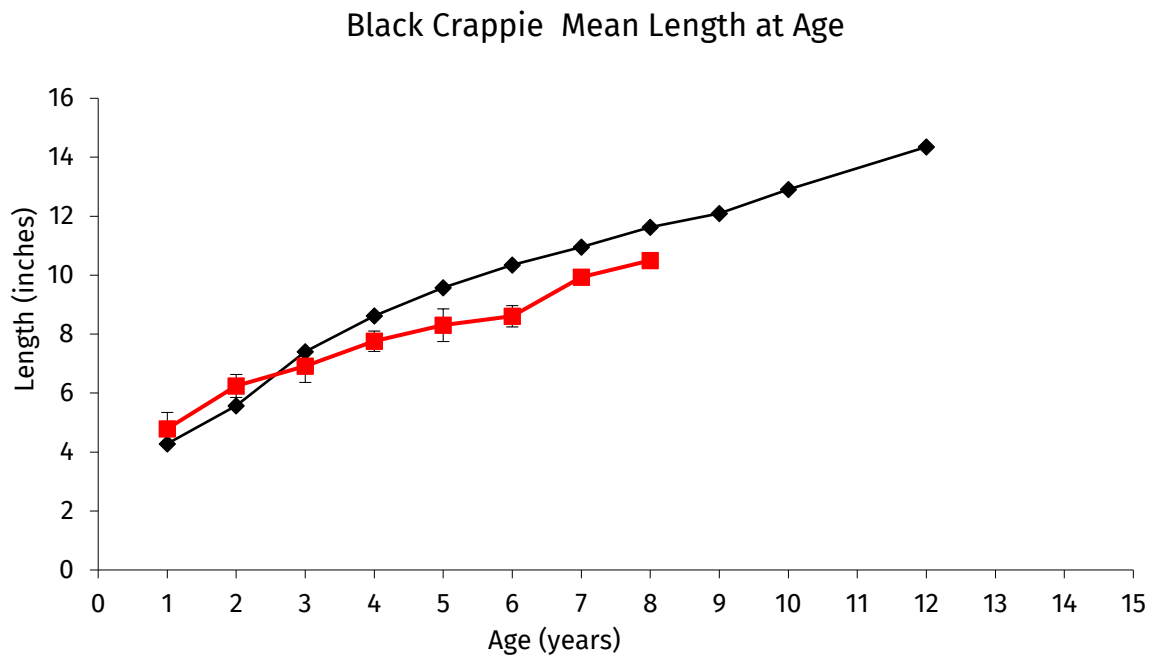


Figure 18. Black crappie growth rates in comparison to statewide averages. Cox Hollow Lake values are shown in red (± 1 SD); statewide averages are shown in black.

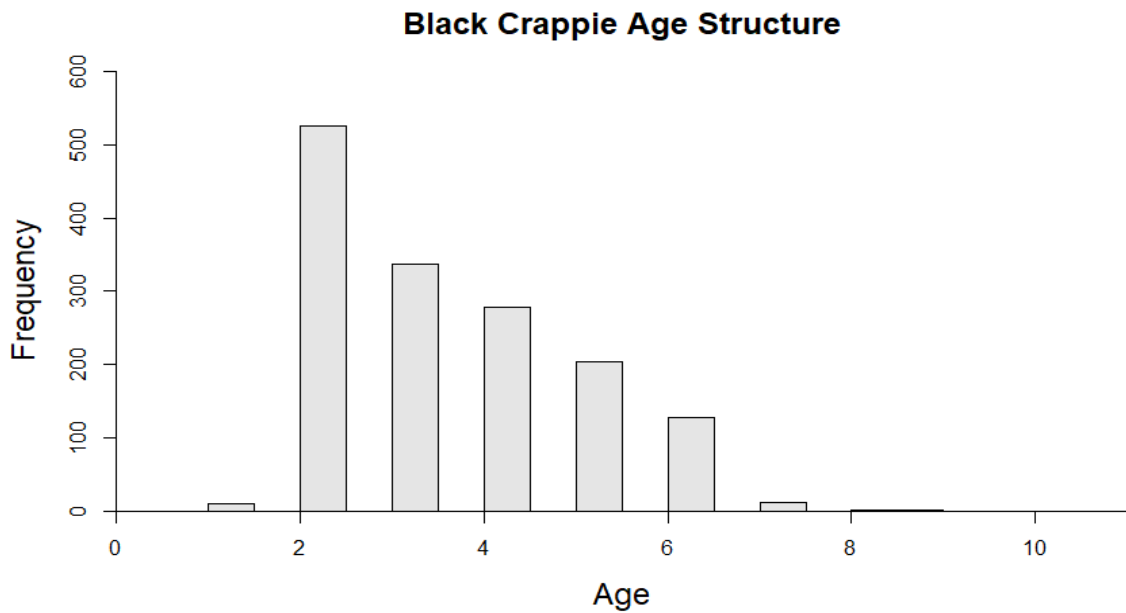


Figure 19. Age structure of black crappies collected during spring sampling in Cox Hollow Lake. Lengths from aged fish were extrapolated and applied to unaged fish using age-length keys.

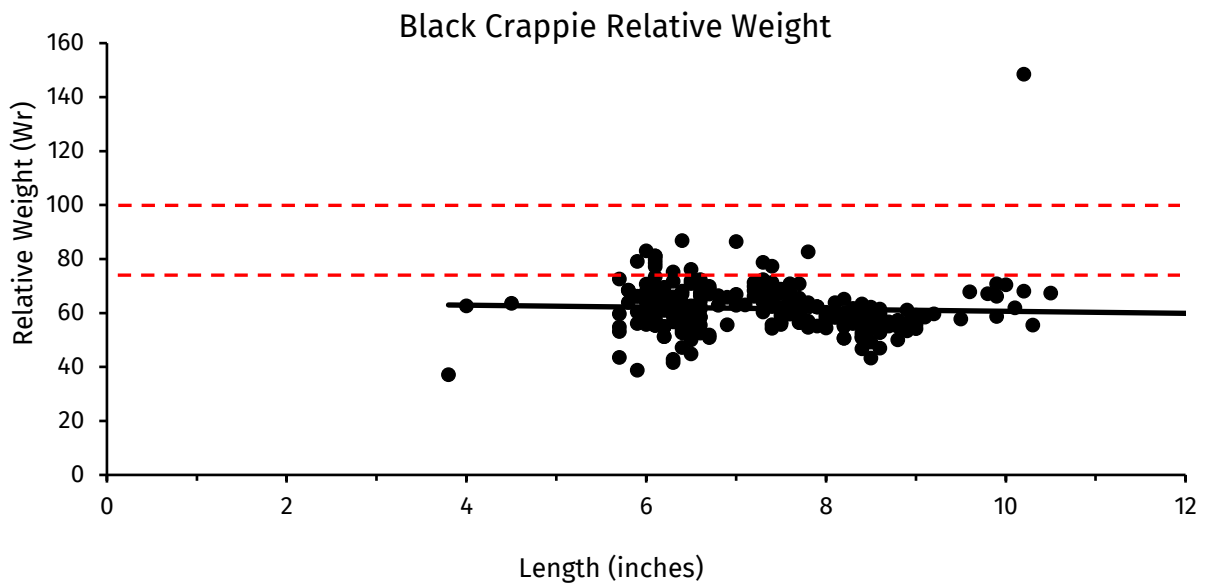


Figure 20. Relative weights of all black crappie sampled during spring electrofishing surveys. Fish between 75 and 100 (designated by red dashed lines) are considered to be within the normal range.

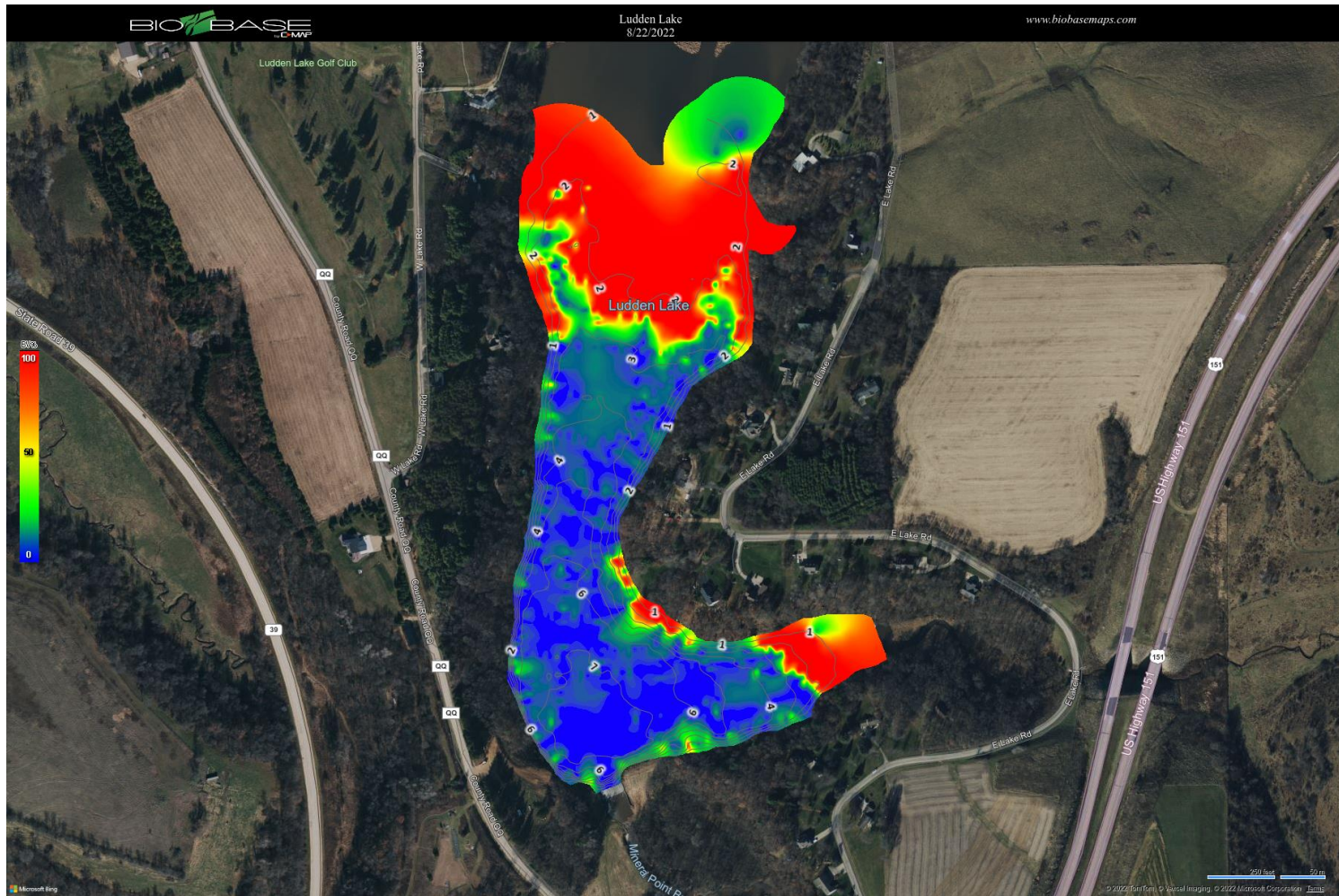


Figure 21. Biobase vegetation map of Ludden Lake.

Table 1. Fish stocking records for Ludden Lake, Iowa County, Wisconsin since 2013.

Year	Species	Age Class	Number Stocked	Average Fish Length (in)
2013	WALLEYE	SMALL FINGERLING	1015	1.4
2013	WALLEYE	FRY	50000	0.2
2015	WALLEYE	SMALL FINGERLING	2996	1.5
2017	WALLEYE	SMALL FINGERLING	1970	1.6
2019	WALLEYE	SMALL FINGERLING	2165	1.2